HADDAM NECK

HISTORICAL REVIEW TEAM REPORT

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LIST OF ACRONYMS AND ABBREVIATIONS

ACR - Abnormal Condition Report
AEC - Atomic Energy Commission
ALARA - As Low As Reasonably Achievable
AOR - Abnormal Occurrence Report
B&W - Babcock & Wilcox
BNFL - British Nuclear Fuels, Limited
BOL - Beginning Of Life
BTP - Branch Technical Position
BWST - Borated Water Storage Tank
Ci - Curie(s)
CP - Construction Permit
CY - Connecticut Yankee
CYAPCO - Connecticut Yankee Atomic Power Company
DEI - Dose Equivalent Iodine
ECCS - Emergency Core Cooling System
ECT - Eddy Current Testing
EPA - Environmental Protection Agency
EPRI - Electric Power Research Institute
FDSA - Facility Description and Safety Analysis
FERC - Federal Energy Regulatory Commission
FES - Final Environmental Statement
FSAR - Final Safety Analysis Report
FTOL - Full Term Operating License
GDC - General Design Criteria
ISAP - Independent Safety Assessment Program
kW - kilowatt
LACBWR - LaCrosse Boiling Water Reactor
LCO - Limiting Condition for Operation
LER - Licensee Event Report
LHGR - Linear Heat Generation Rate
LLD - Lower Limit of Detection
LLDP - Low Level and Decommissioning Projects
LOCA - Loss Of Coolant Accident
MCL - Maximum Contaminant Level
MTU - Metric Ton Uranium
MWD - Mega Watt Day
MWe - Mega Watt electric
MWt - Mega Watt thermal
NEPA - National Environmental Policy Act
NMSS - Nuclear Material Safeguards and Safety
NRC - Nuclear Regulatory Commission

NU - Northeast Utilities
ODCM - Offsite Dose Calculation Manual
PAB - Primary Auxiliary Building
PCP - Process Control Program
PCT - Peak Cladding Temperature
PDCR - Plant Design Change Request
PIR - Plant Information Report
PN - Preliminary Notification
POL - Provisional Operating License
PORC - Plant Operating Review Committee
PSDAR - Post Shutdown Decommissioning Activities Report
QA - Quality Assurance
RCA - Radiation Control Area or Radiologically Controlled Area
RCS - Reactor Coolant System
RETS - Radiological Effluent Technical Specifications
RG - Regulatory Guide
RWST - Refueling Water Storage Tank
SALP - Systematic Assessment of Licensee Performance
SDMP - Site Decommissioning Management Plan
SEP - Systematic Evaluation Program
SER - Safety Evaluation Report
SGTR - Steam Generator Tube Rupture
TLD - Thermoluminescent Dosimeter
TS - Technical Specifications
UFSAR - Updated Final Safety Analysis Report
USQ - Unresolved Safety Question
UT - Ultrasonic Testing
XPE - Xenon Pin Equivalent

NRC TEAM REPORT - HISTORICAL REVIEW OF HADDAM NECK

A. Objectives

The objectives of this review were to: (1) gain better understanding and appreciation of the scope and extent of previous radiological occurrences in order for the NRC to better assess the acceptability of the licensee's future site radiological characterization efforts and subsequent remediation of affected areas, on-site and in the environment; and (2) identify whether licensee activities that resulted in contamination of the site, uncontrolled or unmonitored effluent releases, or insufficient control of licensed materials were considered for (or subject to) action relative to existing NRC regulatory requirements, including enforcement.

While sufficient for its purpose, this effort was not intended to be an exhaustive study and review of every contamination event and circumstance that occurred within the 30-year operational period of the Haddam Neck plant. Nor was it intended as a comprehensive examination and assessment of every regulatory action, document or record that might have pertinence. This report is not a substitute for the licensee's historical assessment being conducted as part of the site characterization. Rather, this effort was designed to provide understanding, clarification and perspective of licensee practices that resulted in facility contamination and certain significant events or conditions that had the potential to affect public health and safety or impact the environment. Accordingly, the NRC team selected and examined events and circumstances that appeared to be most significant and provided the best insight into Haddam Neck's past performance regarding radiological control, along with the NRC's corresponding oversight.

B. Approach

To accomplish these objectives, the NRC team reviewed documentation pertaining to licensee performance and NRC regulatory activities over the operating period of the plant relative to the stated objectives. Documents from 1966 to 1997, were reviewed at the Haddam Neck site, at NRC Region I, and at NRC Headquarters. NRC Regulations and radiation detection technology evolved over that period, which required the NRC team to review events in context with the regulations and technology in existence at the time. The NRC team's findings and observations for each objective are documented in separate Appendices to this report.

Appendix A, "Review of Licensing/Design, Processes and Events That Led to Radiological Occurrences," describes findings and observations regarding: (1) the licensee's historical review of events and circumstances that led to certain radiological occurrences that affected the radiological status of the site; (2) offsite contamination as a result of licensee practices; (3) the process for monitoring and controlling the release of radioactively contaminated materials from the site; (4) the licensee's documented radiological environmental monitoring reports; (5) the licensing basis and operating experience associated with radioactive waste

processing; (6) the process and practices for monitoring and controlling non-radiological system and release pathways that became contaminated due to events or licensee practices; and (7) the licensee's experience with stainless steel clad fuel, and the events and circumstances that resulted in fuel clad defects. Appendix A also includes supplementary information, having pertinence to these findings, such as copies of licensee's initial scoping survey maps, for further clarification and understanding.

Appendix B, "NRC Response to Radiological Occurrences and Events," describes past AEC and NRC inspection and enforcement response regarding the circumstances and conditions that resulted in various contamination events. These details include observations and findings regarding the licensee's efforts to report events, the NRC response to significant events and review of the inspection record, including enforcement action. For perspective, information on the scope and extent of enforcement, in other regions and on similar issues, is described. Supplementary information, i.e., chronological summary of events and NRC response, and listing of NRC enforcement actions specific to Haddam Neck, is provided.

Appendix C, " Background and General Regulatory Perspective," describes the emerging radiological control performance issues that led NRC to establish an action plan to perform a historical review of the radiological control and area contamination issues at Haddam Neck. A limited discussion on the regulatory functions of NRC and its development over time is also included to provide a perspective to the team's historical review.

C. Executive Summary

Based on currently available information and dose assessments to date, the conduct of licensed activities at the Haddam Neck Plant over the last 30 years apparently did not result in any exposure to the public or environment in excess of the limits specified in 10 CFR 20. However, recent findings from the licensee's historical survey efforts have identified a radiation program breakdown in 1975 that resulted in the inappropriate release of contaminated concrete blocks for unrestricted use. While there is potential for public exposure in excess of 10 CFR 20 limits, based on observed use and condition of these blocks, there has been no evidence of such exposure, to date. The final determination of this matter will require further radiological surveys and additional assessment of the historical use and condition of the blocks.

Operation of the Haddam Neck facility resulted in various spills, leaks, and unplanned effluent release of radioactive materials. There is no evidence that plant operations resulted in the licensee exceeding any public exposure regulatory requirement as specified in 10 CFR 20. However, because of the fuel cladding defects in 1989, there was an instance in which the safety Technical Specification Limit of 10 millirad for the quarterly beta air dose was exceeded. The calculated dose from that event was 11.9 millirad to a hypothetical person at the protected area boundary. In all cases observed, there was no significant radiological consequence to public health and safety.

Most spills and leaks of radioactive materials appeared to have been confined to the Radiological Controlled Area (RCA). The licensee subsequently performed limited remediation to prevent or limit the spread of the contamination. In accordance with licensee

procedures, the material was either disposed of at a low-level waste facility or released for unrestricted use. In addition to the concrete blocks mentioned above, recent findings indicate that some soil and debris, containing low level or trace concentrations of licensed material, were inappropriately released for unrestricted use. The NRC team determined that the circumstances in these cases generally involved either: (1) the licensee's improper application of the limits specified in 10 CFR 30, Schedule A and B (Exempt concentrations and quantities), and 10 CFR 20, Appendix B (Effluent concentrations), as unrestricted use release criteria, or (2) the licensee's failure to maintain effective oversight and control of contaminated materials (e.g., concrete blocks) that were known or suspected of being contaminated. These apparent performance deficiencies were not identified until site characterization efforts were initiated in 1997 during preparation for decommissioning. Subsequent confirmatory measurements and radiological assessments by the licensee, the State of Connecticut's Department of Environmental Protection and the NRC, to date, have not revealed any contamination in any off-site location that currently would exceed 10 CFR 20 limits. Accordingly, the impact on public health and safety is not expected to be significant. However, final surveys and dose assessments have not been completed.

Another factor pertinent to the release of materials from power reactor sites for unrestricted use is the effect of improvements in radiation detection technology. The regulations in 10 CFR 20 governing the disposition of radioactive materials require that any detected activity must be dispositioned in accordance with NRC requirements. However, the sensitive laboratory methods now available permit the application of a lower limit of detection than was reasonably achievable in earlier times. Therefore, it is now possible to detect trace activity in materials that may have been adequately monitored and released in accordance with the existing guidance of that time.

The NRC team reviewed records of the licensing basis for the following: 1) handling of radioactive materials and radwaste processing, along with actual licensee practices, and 2) monitoring of fuel performance over the time period of interest. The licensee's configuration control practices contributed to inadvertent releases from the waste gas decay tank and spent fuel building floor drain. These included a modification of the radioactive waste processing system in 1975 that was not adequately evaluated by the licensee in accordance with 10 CFR 50.59, as well as the conduct of radioactive waste handling activities, in 1989, in the spent fuel building that was not described or reviewed by a safety evaluation. The licensee experienced throughwall fuel cladding defects in 1979 and 1989 that resulted in licensing action. While affecting the radiological condition of the RCA and areas within the licensee's protected area, none of these situations resulted in any circumstances that would be expected to cause significant health and safety consequences relative to the public. Some of these conditions may be potential violations of agency requirements that were not previously identified for enforcement action. However, the doses to workers and the public resulting from these situations were within the requirements of 10 CFR 20. These apparent violations will be further reviewed by the NRC staff and considered for enforcement actions in accordance with the NRC Enforcement Policy (see Appendix B, Section 2.3).

Tritium from routine effluents and from mid-1970's leaks in the underground liquid waste test tank lines resulted in onsite groundwater contamination and measurable concentrations in the Connecticut River. Because characterization of the tritium plume has recently begun,

it may be possible that higher concentrations could be detected as well as the identification of other contributing sources. A selected review was performed of the licensee's Annual Radiological Environmental Reports. As required, the licensee reported tritium in groundwater and the Connecticut River. Dose consequences to the public were within the limits of 10 CFR Part 20 and the EPA Maximum Contaminant Level established in 1976. Independent environmental monitoring by the State of Connecticut was in agreement with the licensee's data.

The team determined that the licensee's formal event notifications were generally in accordance with the requirements of 10 CFR 50.73 and 10 CFR 50.72. Exceptions included a late and incomplete notification of the fuel defects in 1989 and the 1997 discovery of contamination that had been released from the RCA and disposed of in a landfill within the owner-controlled area, which was accessible to the public. Regarding the 1989 fuel defects, this event resulted in the plant exceeding a design basis limit (1% failed fuel assumed in the waste gas decay tank rupture accident), but apparently the licensee did not recognize or report this event as such.

Previous NRC inspection activities were generally conducted in line with agency rules and regulations in effect at the time. Over the last 30 years, NRC inspection reports documented the agency's reviews of plant programs that included radiation protection, radiological controls, radiological waste processing, and effluent and environmental monitoring. The staff weighed a number of factors in deciding on the nature, extent and timing of NRC follow-up to events at the plant. These included the apparent safety significance, the general performance of the plant operator in the area involved, and competing inspection priorities. The team did not attempt to reconstruct the factors or competing inspection demands that influenced the staff's response and follow-up to past events or occurrences. Nevertheless, the team was able to conclude that for most radiological events, NRC follow-up was commensurate with the expected safety impact and was, therefore, appropriate. Spills and releases typically involved limited contamination and did not result in appreciable dose to workers, the public, or environmental impact, and did not effect operation of the facility. The licensee generally conducted remediation of spills and contamination occurrences in owner controlled areas when contamination was identified. While NRC did not always examine each individual occurrence, normal inspection program activities were sufficient to verify that remaining residual contamination would not result in radiological exposure to workers or the public in excess of regulatory requirements. In general, the agency's focus in radiological control inspections was principally on assuring that the licensee's programs for environmental and effluent monitoring, and radiation protection and radiological control were maintained in conformance with regulatory requirements. Further, the priority for both the plant operator and the NRC inspection program was on the immediate control of radiation exposures to workers and the public, and generally did not consider the potential affect of site contamination events on future decommissioning, including financial impact. These priorities may have led to limited assessment of some individual radiological events. Under these circumstances, there were possible missed opportunities to gain performance insights that may have affected the NRC's assessment of the plant operator's overall performance and consideration of possible enforcement action.

Enforcement action was usually taken for operational problems that were considered safety significant, but not for small spills and releases, because of the negligible dose impact to plant workers or the public. Further, these smaller events did not contaminate areas outside the protected area which was consistent with the licensing basis of the facility. Therefore, the application of enforcement action varied with the specific circumstances and the safety significance of each event. It is apparent that there were a few missed opportunities where NRC should have taken enforcement action in the past. These items will be further reviewed and evaluated using the NRC enforcement policy to determine any actions that may be taken.

D. Conclusions

The scope and depth of the licensee's current effort to review past radiological occurrences and assess significance are appropriate and sufficiently comprehensive for the site radiological characterization, as required by 10 CFR 50.82(a)(9)(ii). This was determined by the team's review of the licensee's initial scoping efforts for site characterization, as documented in the following: radiological classification of plant systems and land areas; surveys and reports of past operational occurrences; procedure review for releasing materials from the facility for unrestricted use; and licensee interviews with personnel and members of the public, who acquired materials from Haddam Neck. The licensee's continuing efforts to finalize the site radiological characterization will be a focus of future NRC inspections.

Over the 30-year operating period of the plant, there were several occurrences and events that resulted in contamination of the facility and the immediate environment. Fuel clad defects led to increased radiological source term and deposition of transuranic activity in radiological and non-radiological plant systems. In 1979, while operating with an increased transuranic source term in the primary system, Haddam Neck experienced several inadvertent liquid and gaseous releases. The contamination outside the RCA from these events was not discovered by the licensee for several months. Isolated spots were found in the protected area and at the parking lot within the owner controlled areas. No significant impacts were identified by the licensee's environmental monitoring program. Although remediation of identified areas was completed in 1980, recent scoping surveys of the hillside have identified some small spots with transuranic and other fission product activity. Because of the radiological waste filtration and clean-up systems, most spills and releases to the environment that occurred did not impact areas outside the owner-controlled property. However, tritium entered the environment through routine effluent releases and system leakage. These conditions were within regulatory requirements.

Recent revelations of low-level or trace concentrations (quantities) of licensed materials in some off-site locations provide evidence of previous deficiencies in licensee procedures or performance with respect to radioactive material control. Subsequent off-site confirmatory measurements and assessment of the existing conditions by the licensee, the NRC and the State of Connecticut-Department of Environmental Protection have not revealed any radiological concentrations or subsequent exposures significant to public health and safety, to date. Evaluations and assessments are still in progress.

The NRC team noted that the current technological capability permits the application of a lower limit of detection than was reasonably achievable in earlier times. As such, it is now possible to detect trace activity in materials that were effectively monitored and released in accordance with the existing guidance at that time.

The performance of NRC inspection activities at Haddam Neck, and the application of enforcement, was generally consistent with the existing policy of the NRC and practices that evolved over time. Major operational events and larger spills or releases were typically reviewed and considered for potential enforcement actions. Events that were expected to have minimal impact on workers, the public, or the environment received limited NRC review and follow up that was consistent with inspection priorities. Notwithstanding, it is apparent that there were a few opportunities for the agency to more rigorously review events or situations to determine the appropriate enforcement actions. These items will require further review and consideration in accordance with the NRC enforcement policy. This review will consider the relationship of the issues to the current licensed activities and the need for corrective action to prevent recurrence.

This team effort has provided the agency with better information with which to review and evaluate licensee plans, procedures and work to decommission the facility and remediate affected areas.